

OFFICE OF NAVAL RESEARCH
PUBLICATIONS/PATENTS/PRESENTATIONS/HONORS REPORT
15 MARCH 1992 through 30 September 1992

DTIC
ELECTE
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R&T Number: uri41132--01

Contract/Grant Title: "Interaction of Vorticity with a Free Surface"

Scientific Officer: Edwin P. Rood

Principal Investigator: Morteza Gharib

Mailing Address: UCSD, Dept. of AMES, 0411, 9500 Gilman Drive, La Jolla, CA
92093-0411

Phone Number: (619) 534-6002

FAX Number: (619) 534-8977

E-Mail Address: mgharib@ames.ucsd.edu

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| a. Number of Papers Submitted to Referred Journal but not yet published: | -0- |
| b. Number of Papers Published in Referred Journals:
(List Attached): | -0- |
| c. Number of Books or Chapters Submitted but not yet Published: | -0- |
| d. Number of Books or Chapters Published (List Attached): | -0- |
| e. Number of Printed Technical Reports & Non-Referred Papers (List Attached): | -0- |
| f. Number of Patents Filed: | -0- |
| g. Number of Patents Granted (List Attached): | -0- |
| h. Number of Invited Presentations at Workshops or Professional Society Meeting (List Attached): | -0- |
| i. Number of Presentations at Workshops or Professional Society Meetings (List Attached): | 1-CCNY
1-UCSD |
| j. Honors/Awards/Prizes for Contract/Grant Employees:
(List Attached, may include Society Awards/Offices, Promotions, Faculty Awards/Offices, etc.) | |

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k. Providing the following information will assist with statistical purposes.

PI/CO-PI:	TOTAL	<u>1</u>	Grad Students:**	TOTAL	MIT = 1
	Female	<u>-0-</u>		UCSD = 4	
	Minority*	<u>-0-</u>		Female	<u>1</u>
				Minority*	<u>-0-</u>
				MIT	= 1
	Post Doc:**		TOTAL	UCSD = 0	
			Female	<u>-0-</u>	
			Minority*	<u>-0-</u>	

1. Degrees Granted (List Attached):

1 - Chris Willert

* Underrepresented or minority groups minorities include Blacks, Hispanics, and Native Americans.
Asians are not considered an under-represented or minority group in science and engineering.

** Supported at least 25% this year on contract/grant.

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ENCLOSURE 3

Enclosure(1)

LIST OF PUBLICATIONS/REPORTS/PATENTS/GRADUATES

1. Papers Published in Referred Journals:

2. Books (and sections thereof) Published:

3. Technical Report, Non-Refereed Papers:

4. Presentations:

19th Symposium on Naval Hydrodynamics, paper presented by Mory Gharib,
Aug. 23-28, 1992, Seoul, South Korea

1992 ASME Fluids Engineering Conference, paper presented by Mory Gharib,
June 21-24, 1992, Los Angeles, California

XVIIIth International Congress of Theoretical and Applied Mechanics,

paper presented by George Triantafyllou, Aug. 22-28, 1992, Haifa, Israel

5. Patents Granted:

6. Degrees Granted (name, date, degree):

Chris Willert, 8/20/92, Ph.D.

Enclosure (2)

LIST OF AWARDS/HONORS/PRIZES

Name of Person
Receiving Award

Recipient's
Institution

Name of Award

Sponsor of
Award

Enclosure (3)

OTHER SPONSORED RESEARCH

(Include title, sponsors's name, dollar amount and start and end dates for the award)

"A Collaborative Study of Turbulence-Generated Noise and
Development of Fast Image Correlation Velocimetry Techniques,"
DARPA/ONR/N00014-91-J-1968, \$427,172 (UCSD portion),
9/1/91 - 9/30/94.

Enclosure (4)

Interaction of vorticity with a free surface

M. Gharib
Institute for Nonlinear Science

PROJECT ABSTRACT

Long Term Goals:

We intend to combine numerical, theoretical and experimental efforts to systematically extend our capabilities to understand and model vortical and turbulent flows near a free-surface.

Near Terms Analysis

We have 5 near term objectives:

1. Continue and complete experimental and numerical studies of the laminar vortex rings and pair interaction with a free-surface. The goal is to address high Reynolds number issues. Three dimensionality, free surface nonlinearities, ambient waves and surface tension.
2. Conduct experiments in order to understand the effect of surface tension variations on the vorticity/free-surface interaction.
3. Develop experimental and numerical approaches to study interaction of turbulence with a free-surface with and without waves, and the surface features associated with the underlying vortical flows.
4. Develop diagnostic techniques to measure a) 3D velocity field, b) surface elevation, c) surface tension.

5. Design of a surface shear-layer facility.

APPROACH:

Approaches for each of the near term objectives are described in the main text of the original URI proposal. For the sake of brevity we avoid to repeat the description of the proposed methodologies.

Task Completed:

Experimental Efforts:

1. Design of the shear layer facility is completed and manufacturers are selected. Delivery is scheduled for May 1993.
2. Video based surface color mapping system is assembled and tested.
3. High speed version of the DPIV system is completed. The design of the 3D version of the DPIV system is completed.
4. Experiments on the laminar vortex ring and pair interacting with the free surface is completed.
5. Experiments on the interaction of a near surface jet with the free surface is completed.
6. Conceptual design of a dynamic system to measure surface tension is completed.
7. A new water tank facility to study grid turbulence interaction with the free surface was fabricated and preliminary experiments were conducted.
8. Since the project initiation, we have also installed a DPIV system in the 25mm long MIT Testing Tank Facility. Flow visualization and DPIV measurements behind towed bodies is being planned.

Computational Efforts

To date, we have made progress in (i) understanding the role of nonlinearity in the free-surface boundary conditions; (ii) development of new 2D and 3D direct Navier-Stokes solvers; (iii) investigation of the interactions between the free surface and a vortex pair with special focus on the importance of the presence of ambient waves; (iv) the study of the interaction between a free surface and a vortex ring with particular attention to the quantification of the reconnection process; and (v) a fundamental study and simulation of soluble surfactants and its effect on the underlying free-surface vortical flows.